REPORT OF THE CHIEF OF THE BUREAU OF HUMAN NUTRITION AND HOME ECONOMICS, AGRICULTURAL RESEARCH ADMINISTRATION, 1946

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., September 15, 1946.

MR. P. V. CARDON,
Agricultural Research Administrator.

DEAR MR. CARDON: I submit herewith the report of the Bureau of Human Nutrition and Home Economics for the fiscal year ended June 30, 1946.

Sincerely,

HAZEL K. STIEBELING,
Chief.

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With wartime emergency programs completed, the Bureau of Human Nutrition and Home Economics is now able to focus attention on its long-time research objectives. These are threefold.

First is defining more clearly basic human needs for food, clothing, and the other goods and services that enter into everyday living. Naturally, men, women, and children of different ages vary in their needs. So also do people engaged in different kinds of work and living in the multitude of ways people can live in a country as varied as this is in climate and opportunity.

A second objective is to find more about the nature of the goods serving human needs. Take food as an example. Though more research has been done on food in relation to the body's nutritional needs than on any of the other necessities of life, only the surface of this

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subject has as yet been scratched. Much also remains to be found about the nutritive value of food, especially as affected by processing, storing, cooking, and all the things that happen to it on the way from farm to consumer's plate. And beyond even that the combination of foods in day-by-day diet may have a great deal to do with the way the body can make use of the different nutrients.

Besides a clearer definition of basic human needs and more thorough study of the goods serving those needs, it is essential, as a third objective, to have a comprehensive picture of what American families buy and use, and how family use is affected by income, family size, and household management practices. This picture, moreover, needs to be drawn periodically. Trends can then be observed and effects of war, depression, and other major and minor economic changes traced. By comparing this picture of America's consuming habits with basic needs, it is also possible to tell whether as a Nation we are becoming better fed, better clothed, better housed, and how wide is the gap between our practices and our goals.

Under these three guiding principles the Bureau's studies deal specifically with the home use of food, fiber, and other products of agriculture. Economic problems of family living as a whole—particularly rural family living—are an integral part of the program. The past year's oustanding accomplishments in these various fields are summarized in the following pages.

NUTRITIVE VALUE OF NATIONAL FOOD SUPPLY

As one way to find whether the American diet is improving and in what respects, the Bureau completed this year a study of the nutritive value of the civilian food supply over a 37-year period—1909 through 1945. Thus were brought to light trends through war and peace, good times and depression.

Starting point for this study was estimates of the Bureau of Agricultural Economics of the annual per capita consumption figures for some 170 different foods—such as milk, meats, poultry, eggs, grains, fruits, vegetables, sugars, and fats. Then, using the latest average figures for calories, proteins, vitamins, and minerals in these foods, the Bureau of Human Nutrition and Home Economics computed the nutritive value of the Nation's per capita food supply.

Outstanding facts revealed are that during the recent war years food for American civilians on the per capita basis contained more calcium, iron, B vitamins, vitamin A, and vitamin C (ascorbic acid) than at any other time in the 37-year period. Important factors in bringing about these wartime nutritional gains were increased consumption of milk, eggs, vegetables, and fruit and the enrichment of white bread and flour. Calorie and protein levels during World War II were somewhat higher than in the 1930's, but not above consumption in the decade prior to 1920.

Over the course of the whole period, there was a steady increase in calcium, vitamins A and C, and riboflavin in the B-vitamin group. The rise in calcium and riboflavin was due largely to greater consumption of milk, the rise in vitamins A and C to increased use of fruits and vegetables. Accounting in large measure for this increase in vitamin C was the more than fourfold increase of citrus fruits since 1909.

Thiamine and niacin hit all-time lows in 1935, coincident with a sharp fall in meat supply, especially pork. Since then these values have been on the upgrade, associated in part with higher meat consumption, in part with enrichment of a large proportion of the flour, bread, and cereal.

A study such as this, revealing trends in national food habits over a long period, furnishes perspective against which to appraise current supplies, probable effect of food emergencies, and the nutritive value of the food of various nations. This report is of great interest to commercial, governmental, and educational agencies, and each is finding in it valuable material to guide future programs.

NEW METHOD FOR DERIVING FOOD BUDGETS

To meet a long-felt need, an objective method has been devised for deriving family food budgets from customary food patterns and in accord with a selected set of nutritional specifications. The method makes use of actual records of the food purchased or home-produced by families and relies on statistical procedures rather than the decisions of the nutritionist to determine the exact quantity of various food groups needed to make up a diet that will meet the given standard. A budget has been developed by this method, giving the quantity of 11 main food groups needed by a family of husband, wife, and two children to achieve a diet that just meets the recommended allowances of the National Research Council. This new method is a valuable tool for developing plans for adequate diets appropriate to different conditions. Within the limitations imposed by the nutrition standards the plans would reflect the food habits that families form in the course of time in response to education and to economic or other environmental situations.

HOW FOODS SUPPLEMENT EACH OTHER IN NUTRITIVE VALUE

The types and proportions of food combined in everyday meals have an important effect upon the utilization of nutrients. Significant at a time when large segments of the world's population are subsisting upon diets high in cereals are the Bureau's studies of the effects on growth and development of laboratory animals of diets high in cereal and other foods of plant origin. The diets were supplemented in turn with dried skim milk, navy beans, and oatmeal, as well as with some purified nutrients.

When diets containing large amounts of bread, white or whole-wheat (up to two-thirds of the calories), along with leafy and root vegetables and small amounts of hydrogenated vegetable fat, were fed to laboratory animals three types of abnormality developed—very low storage of vitamin A in the liver, as compared with expectation in view of the carotene content of the diet, small weight gain per 1,000 calories consumed, and abnormal bone development.

In general the results were more favorable on diets otherwise identical but including whole-wheat bread rather than white. Supplementation with several foods and nutrients are under study. Of those investigated to date the addition of dried skim milk was most effective in improving nutritional condition.

BIOLOGICAL VALUE OF PROTEIN FOODS

Typical of studies on the nature of foods themselves is the continuing series on the nutritive value and the amino acid content of protein-rich foods of both plant and animal origin. This year it was discovered that the proteins of raw peanut meal have much higher biological values than commercial peanut meals. This suggests that the high temperatures used in industrial preparation of peanut meals are injurious to their nutritive value and that corrective measures could improve the quality of this protein-rich food. Earlier it was found that heat treatment in the presence of moisture improved the quality of soybean protein. Thus some of the discrepancies noted in other reports of the nutritive value of oilseed meals may have been due to variations in the heat to which the materials had been subjected.

More than 30 proteins or protein-rich foods have now been assayed for methionine, a nutritionally essential amino acid containing sulfur, by the two chemical methods and a microbiological method previously developed. The results by the three methods are in close agreement. The microbiological method represents a substantial advance in protein analysis. It has advantages in speed, economy, simple equipment needed, and in the minute quantities of the protein required, and is applicable directly to food materials.

FURTHER DEVELOPMENTS IN DRIED EGG

Poultry husbandmen and food chemists have looked at the egg and long wished that they could do something to improve its contribution to the calcium content of the human diet. For while the eggshell is nearly half calcium, both yolk and white are notably low in this nutrient. Now technological advances have made dried egg a staple product for commercial bakers and opened the way to its use in home kitchens. In view of this widening popularity it seemed feasible to experiment in increasing the calcium content of dried egg by adding ground shell. A series of studies was therefore planned to try out the cooking quality and palatability of the "fortified" product when used in the same way as ordinary dried egg.

It was found that the addition of 0.4 percent eggshell ground to pass a U. S. No. 400 sieve (openings of 0.0015 inch) yielded a product which could be used without detection in scrambled eggs, custards, ice cream, foundation cakes, muffins, popovers, and yeast rolls. Eggshell particles somewhat coarser than the 400-sieve size were not detectable in baked custards, in vanilla-flavored refrigerator ice cream, or in foundation cake and yeast rolls.

A number of the Bureau's earlier studies on dried egg have now been printed and the continuous demand for recipes for home use indicates consumer interest both here and abroad.

SCHOOL LUNCH STUDIES

Passage of the National School Lunch Act, providing for continued financial aid to more schools than in the past has released a flood of demands for information on school feeding methods. The act, carrying as it does funds for equipment, will stimulate installation of lunchrooms in old as well as new school buildings. Basic information is

needed by Federal, State, and local administrators for making decisions in the use of funds for food and nonfood purposes.

During the past year the Bureau made a preliminary study of school lunchroom facilities in villages to find out the essential operating characteristics of a successful and sustained school lunch program. Much of the available information on school lunch operations deals with urban situations. In rural communities problems may differ with respect to marketing, delivery, and storage of food, responsibility for management, availability and kind of workers, and use of the lunchroom for other school purposes.

Nine schools in three States have been observed systematically and a preliminary report is being prepared. The study shows that costly mistakes in lunchroom arrangements had been made in some degree in all buildings. Among these were too small kitchens, insufficient refrigeration, inadequate space for handling soiled and clean dishes, lack of outside entrances convenient for receiving deliveries of food, food-storage space not adjacent to the kitchen, and lack of storage space for supplies other than food. Arrangement of equipment did not always provide for orderly sequence in the preparation and serving of food. In several schools, entrances and exits for pupils necessitated crossing of lines during meal service. Other information gained pertained to the cost and kind of food, methods of preparation, and amounts of labor used. During the coming year the study will be extended to cover a larger number of schools.

As a further aid to the expanded school lunch program, recipes in 100-portion size were selected and tested for palatability and suitability for school lunches. All main-dish recipes were made to meet the requirements for the Type-A meal set up by the Government for schools participating in the Federal lunch program. The new recipes are being published in cooperation with the Production and Marketing Administration and will be in convenient card form to facilitate use by busy lunchroom cooks. These tested recipes will aid food economy by insuring successful preparation of nutritious food that children like. The form in which they are published will facilitate the estimation of food costs.

NEW PROCESSING PERIODS FOR HOME-CANNED FOODS

As a result of 3 years of intensive research on home canning methods, new processes for low-acid vegetables, meat, and chicken are now ready for recommendation to home canners. Thus for the first time the Department has at its command a comprehensive body of scientific facts on canning as it is done under home conditions. Previously it had been necessary to rely heavily upon experimental work done by the canning industry even though practices and equipment differed radically from those used in home canning.

Safe procedures have been developed for 12 vegetables commonly canned at home. In all, over 2,000 pint jars of food were prepared and processed for obtaining heat penetration and bacteriological data. In addition heat-penetration data were obtained from more than 1,000 pint and quart jars and over 700 No. 2 and No. 2½ tin cans. Calculations of the sterilizing values of the process times included values for the heating and cooling periods which are often prolonged when canning is done in glass. Margins of safety are afforded as a result of

basing calculations on the thermal death time, the survival or destruction of a highly heat-resistant organism in inoculated packs, and taking into account such variations likely to occur in household canning as differences in pack density, initial temperatures inside the jar, and timing during the steps of the processing procedure.

Even with the margins of safety thus provided, the new process times for many foods are considerably less than formerly advocated. For food in pint jars processing times 25 to 50 percent shorter are now recommended. However, it is necessary to recommend longer process times than formerly suggested for asparagus, lima beans, corn, and beets when packed in quart jars. Processing temperature for meats is now set at 240° F. instead of 250°, as once recommended in Department publications.

To the 20 million or more American families who annually make a practice of canning some of their food supply, these new processing times and lower temperatures can mean home-canned products of higher nutritive value and more appetizing flavor, color, and texture. They can also mean cutting down much spoilage and waste. Out of one war year's 4-billion-quart pack of home-processed food, there was estimated spoilage of 45 million quarts. Much of the annual loss of home-canned food is traceable to unsound processing methods and failure to understand the scientific principles behind home-canning procedures.

The technical report on which these new canning processes are based is now being printed. As soon as this becomes available, conferences will be held with extension workers, canning-equipment manufacturers, magazine editors, and others interested in giving the public the latest scientific information on home canning.

The completion of this work on 12 commonly canned low-acid vegetables, 2 meats, and 1 kind of poultry marks a long step forward in improving home-canning processes. The job is not finished, however. Work on other products is now under way in cooperation with research groups in Texas and Massachusetts. Also, perhaps more of the attractive appearance and nutritive value of the fresh food can be retained by improved treatment of the food before it is packed into the container, or even by the method of packing itself. Even more basic to keeping quality and wholesomeness of home-canned food, much remains to be learned about the micro-organisms that cause spoilage. Present processes for low-acid foods are directed against that most dangerous organism *Clostridium botulinum.* On the canning technologists' blacklist are many other micro-organisms probably responsible for spoilage in fruits and tomatoes. But the behavior of these organisms has not yet been investigated with the same thoroughness given to the deadly botulinum in low-acid food. These are fields for next study in order to place home canning of all types of food on a sound scientific basis.

EQUIPMENT AND METHODS FOR HOME FREEZING OF FOODS

The two-point attack on the home freezing of foods includes investigation of the performance and operating characteristics of home freezers and of methods of handling the food to retain palatability and nutritive value when frozen and stored for varying periods of

time. Broad as this subject is, conspicuous advances have been made in both lines during the past year.

The work on performance of home-freezing units is of import both to manufacturers and users of this type of equipment. For in order to be satisfactory a home freezer must not only do the initial freezing of the food effectively, but it must provide the right conditions to keep the frozen food so that it retains its good eating quality and nutritive value for storage periods as long as from one growing season to another. Moreover, the freezer should be able to repeat this performance year after year and at economical operating cost.

Freezers of basically different designs have been studied under engineering-test and performance-in-use conditions, and detailed reports of the results supplied to manufacturers. In many instances these data aided manufacturers in improving their designs and in making recommendations to users of their equipment. Among the most important improvements have been reduction in the size of recommended maximum freezing load and reduction in size of freezing compartment so that the temperature of the food in the storage compartment will not be greatly affected during the freezing of a capacity load.

This Bureau has pioneered in the development of a procedure for testing the performance of home freezers and has taken a leading part in the development of a standard procedure. At our request, the American Standards Association has enlarged the scope of its household-refrigeration committee and set up a subcommittee under the cosponsorship of the Bureau for the development of an American Standard test procedure for home freezers. The adoption of such a procedure, in addition to bringing about better freezer performance in general, will promote a set of uniform criteria and will enable the prospective purchaser to evaluate more easily the statements made as to freezer performance and to select more intelligently among designs and models.

Research of last year showed that during times when freezers were not operating, because of power outage or mechanical failure, the temperature of the cabinet rose rather rapidly. This, of course, may have undesirable effect on the palatability and even safety of foods in the cabinet. Accordingly a study was made to find effective home methods of delaying the warming-up of stored frozen foods until repairs might be made.

External insulation (blankets) alone was found to be ineffective in retarding temperature rise. In chest-type cabinets with one-fourth load, 40 pounds of solid carbon dioxide prolonged the period before 15° F. was reached by about 36 hours, the total time being about 48 hours. Best results with solid carbon dioxide alone were obtained when none of the food was stored in the freezing compartment and the solid carbon dioxide was divided among the storage compartments in single pieces, roughly proportional to compartment volume. External insulation used with solid carbon dioxide retarded warming-up to 15° by a few hours. A delay of 7 or 8 hours before adding the solid carbon dioxide made little difference in the time required for the stored frozen food to reach 15°. Doubling the amount of solid carbon dioxide prolonged the time by about 50 percent. Successive charges of solid carbon dioxide can be used to prolong it still further.

Not only mechanical failures but fluctuations in freezer temperatures occurring in varying degrees either when a load of food is being frozen or when the cabinet doors are opened for relatively long periods may affect the quality of the stored food. In cooperation with Cornell University, investigations have been made to determine the effect of such fluctuations on the quality of stored frozen food.

Marked changes in quality were found to occur in frozen food when subjected to temperature changes varying from 0° to 20° F. with the storage compartment at the higher temperature only about one-fourth of the time. The quality of peas, snap beans, and pork roasts was decidedly inferior, approximating the same as that obtained when the foods were stored at a temperature of 10°. This information has significance to manufacturers in developing designs and for instructions to families on care and use of freezers.

In cooperation with Iowa State College, it was found that the frozen-food storage compartment of a household refrigerator should provide temperatures below 10° F., preferably 0° to 5°, in order to maintain desirable quality of frozen food during short-period storage.

In order to learn more of the effect of method of preparation for freezing on the quality of food when frozen and stored, an evaluation of the palatability and nutritive value of frozen peaches, partially reported last year, has been completed. This study included more than 700 packages of the frozen fruit. With the two varieties studied, addition of ascorbic acid to the sirup was found to be the most successful treatment for preventing darkening of the fruit and promoting high palatability and nutritive value. For the treatment of a 1-pint carton of peaches, retail cost of crystalline ascorbic acid is estimated now at only about 1 cent. A commercial dip known as thiourea used prior to packaging in sirup or sugar also was successful in preventing darkening but, because its safety to health has been questioned, its use will not be recommended until further information is available. A sodium bisulfite dip in the concentration used, bleached the color and adversely affected flavor. A citric acid dip gave results similar to sirup-packed peaches; some browning and loss of vitamin C occurred but flavor and texture were satisfactory.

Other conditions were found to affect the quality of the frozen fruit. Peaches frozen in slices maintained better texture but lost more flavor than those frozen in halves. Peeling without scalding gave better results than peeling after scalding in boiling water, because the latter resulted in a translucent or cooked layer that sloughed and discolored during storage. Of seven varieties of peaches studied, the Sunhigh ranked highest in flavor throughout storage, while Elberta scored highest in texture and only a little lower in flavor. A soft-fleshed peach, Golden Jubilee, was poorest in quality during frozen storage.

Continued work with frozen vegetables showed the comparative advantages of different methods of preparation for freezing, and the adaptations required for various vegetables. Water scalding of peas and cauliflower gave better flavor, texture, and ascorbic acid value in the frozen product than steam scalding. The reverse was true of broccoli, while the two methods gave equally good results with asparagus and snap beans.

Studies with snap beans revealed that it is possible to save time and fuel by using the same hot water for scalding several lots, since serial scaldings did not affect the ascorbic acid loss from the vegetable. Losses due to holding beans at room temperature prior to scalding were less if the cutting was a last-minute procedure.

The importance of inactivating enzymes is shown by the fact that ascorbic acid in frozen snap beans was destroyed in 2 to 4 weeks if the activity of the enzyme catalase was unchecked by scalding. A 1-minute scald, which inactivated the catalase but not the peroxidase enzyme, gave good retention of ascorbic acid. A 3-minute scald completely inactivated both enzymes but resulted in greater loss of ascorbic acid for other reasons.

HOUSING NEEDS OF FARM FAMILIES

That families on farms need better housing for greater comfort in living and increased efficiency in household operations is a matter of common knowledge. Also in a general way it is known that they need and want adequate space for work and recreation, energy- and time-saving arrangement of rooms and of equipment and facilities within rooms, and properly designed closets and cabinets for long- and short-time storage of goods, tools, or equipment. But what is not definitely known is the differences in farm housing needs caused by climatic conditions of various regions, by the amount and kind of work carried on in farm households, and by preferences of homemakers as to where they want to carry on different household activities.

In order to get factual information on these regional requirements in farm housing, a short schedule for a field study has been developed and given preliminary test. This schedule is designed to obtain the facts needed for planning adequate storage facilities, work centers, activity areas, and floor lay-outs for livable rural homes.

Another type of information helpful to farm families considering the remodeling of their houses is the experience of others who have remodeled theirs within the last 10 to 12 years. Such a study is now under way. It will find what improvements farm families have made, what help they had in planning, how they financed their home improvements, how they had kept down costs by doing work themselves, and what major problems they encountered.

Recently 40 families in 5 Ohio counties were interviewed as a pretest for a schedule to be used in gathering information of this sort. During the coming year the schedule will be used with a larger group of families widely scattered throughout the country. Facts disclosed by the Ohio study showed that half of these families had borrowed money, $300 or more, for their remodeling. Thirteen of the families had used some of their own lumber and thus reduced the cash outlay for materials. While practically all the families employed carpenters and other skilled workmen, the men of the family did a great deal of the work themselves and thus reduced the cash outlay for labor. Help with planning the improvements had come from various service agencies, mostly without charge. Only 14 of the families had had floor plans drawn to scale and only 1 employed an architect. Ideas for modernization came from farm journals, magazines, trade publica-

tions, and a few, chiefly on kitchen improvement, from extension agents. All these Ohio homes had electricity and a sink with a drain, but furnaces and bathtubs were still lacking in a third or more. A large majority of all existing facilities had been installed since 1934.

Studies on space requirements for farm household tasks are being carried on in the Bureau's laboratories. Since the kitchen is the most used workshop in the home, where farm women spend one-third to one-half of their working time, any new development in efficient arrangement in this area can do much toward alleviating fatigue. Studies of space requirements for day-by-day food preparation had shown that the largest amount of working surface is needed for baking. For the preparation of baked goods a minimum counter surface 24 by 36 inches is required, and an area 24 by 42 inches affords greater ease and convenience.

To bring together in readable form what is now known regarding desirable farm housing features, a series of popular bulletins under the general title, Your Farmhouse, is being prepared in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering. Since more farm families have signified their intention to remodel existing houses than have indicated that they plan to build new in the near future, first items in the published series are designed to help farm families plan their remodeling so that it will give them the maximum in comfort and satisfaction for whatever outlay of money and labor they decide to make.

In preparation are other bulletins on planning the new farmhouse and planning individual rooms, such as kitchen and utility room, bathroom, bedrooms, living room. A kit with more than 30 plates of "cut-outs" made to scale, depicting floor plans, room arrangements, and standard pieces of equipment and furniture has been developed and is being tried out by the Extension Service in conferences on house planning with farm families.

ELDERLY PERSONS IN RURAL COMMUNITIES

How the older people live is of concern to everyone in an aging population. In 1941, about one out of three rural families included at least one person 60 years of age or over, according to a special analysis of the sample included in a study of family spending and saving in that year. In farm communities there were more aged men than women, 142 men to every 100 women. The numbers were about equal in the nonfarm communities.

In farm communities about one-third of the persons 60 years and over were elderly couples without anyone else in the family, as compared with one-half in rural nonfarm communities living in such family groups.

Among elderly people, living alone was much more common in villages than on farms. Of the men and women 60 years of age and older, 13 percent of those in the rural nonfarm group lived alone in contrast to 4 percent of the elderly on farms.

About one-half of elderly couples or elderly persons living alone in farm or village had money incomes under $500 in 1941. Only about 7 percent had incomes of $2,000 to $5,000. In nearly one-fourth of the farm families with elderly persons these men and women were

living as dependents, but in only one-eighth of the rural nonfarm families was this true.

These facts are among the first emerging from a current analysis of the kind of living of this segment of the rural population. Only when such analysis is made for various groups is it possible to measure need or to advise families on their financial planning.

MISCELLANEOUS CLOTHING PURCHASES

Persons interested in potential markets for cotton can learn much from studies of family expenditures. An analysis of purchases of cotton shirts in 1941 revealed that, on an average, 100 men on farms bought 276 work shirts, 100 in cities, 146. On the other hand, those on farms purchased 104 dress shirts, those in cities 259. As income increased, quantities of work shirts purchased increased only slightly, whereas purchases of cotton shirts other than for work increased markedly. This was true for farm, village, and urban dwellers. The increase in the number of shirts purchased was much greater than that in the price paid per shirt.

Other differences between the buying patterns of the two groups were that urban men bought more, up to three times as many, fine cotton hose, slack suits, pajamas or nightshirts, and suits of cotton underwear. Farm men, as their outdoor occupation would require, bought more heavy cotton socks, gloves, overalls or coveralls, trousers, and union suits made of cotton than did city men. The data show that during the year the rate of purchases of coveralls and overalls per 100 men was 251 for farm men and only 78 for city men; that of cotton socks, 764 pairs for farm men and 896 pairs for urban; of suits of underwear, 255 for farm men and 337 for city men.

DURABILITY OF CONSTRUCTION IN COTTON GARMENTS

Durability is an important factor in cotton work garments, whether purchased or made at home. Under the strain of wear the weakest point in construction often determines the life of the garment. Unfortunately, few data are available from scientific investigations on which to base specifications for details of construction that will insure satisfactory wear. The Bureau in cooperation with the land-grant colleges and State agricultural experiment stations in Ohio and Indiana has made significant progress this year along such lines.

An analysis was made of construction features on 46 women's ready-to-wear house dresses to determine present commercial practice. Observation of seams indicated many unsatisfactory features. Mercerized two-cord thread was used commonly, seam allowances tended to be small, the edges unfinished or pinked, and the number of stitches to the inch small.

Out of 46 dresses examined, only 14 were found to have buttonholes with no defects, while 32 had from 1 to 10 defective buttonholes. The defects included broken stitches, raveled or incomplete stitches, or stitches pulled from the edge. The price of the dress was not a consistent indication of quality of the buttonholes. Some dresses in the second lowest price range examined had buttonholes with few defects, while on the highest priced dress examined, 4 of 10 buttonholes were defective.

Experimental work on buttonholes made by machine with three-cord mercerized thread, size A, showed that increasing the number of stitches from 17 to as many as 30–37 per inch more than doubled resistance to abrasion. Hand-made buttonholes improved as stitches were increased up to 55 per inch, the gain being greatest in the buttonhole placed warpwise.

The durability of edge finishes was studied in more than 100 laundry-owned and laundry-washed jackets and uniforms worn by waiters and waitresses. It was found that faced edges on sleeves and fronts wore longer than hemmed edges in similar positions and that a line of outside stitching increased the durability of faced edges. In general, the stitching on these garments was worn thin or entirely through while the fabrics were still in good condition. Obviously, use of better quality thread would prolong the life of the garment.

How to improve durability through the method of stitching the corners of patch pockets on children's clothes or women's work dresses was given attention this year at Ohio State University. Seven methods, including five commonly used on ready-made garments, were tested to see the effect of strain on the stitching and on the fabric to which the pocket was attached. With fabric identical, sewing thread and number of stitches per inch constant, the breaking strength ranged from 6 to 20 pounds in the seven methods tested. A newly devised diagonal method was found to be very strong. It was nearly twice as strong as the rectangular, the best of the commonly used commercial methods. A special advantage of the diagonal method is the lessened injury to fabric when subjected to strain. In more than half of the specimens tested there was little or no injury.

HOME TAILORING OF WOMEN'S GARMENTS AND CLOTHING CONSERVATION

To help home sewers get greater satisfaction with results, professional tailoring techniques have been evaluated, simplified, and modified for use with home facilities. These techniques included steps in cutting, as well as in construction and finishing. Because some of the results obtained by professional tailors are possible only with the use of special pressing devices, home-made equipment was developed for pressing collar, jacket front, and sleeve—body and top—during construction or in finished garments. Details were incorporated in a bulletin, How to Tailor a Woman's Suit, as a companion piece to an earlier one on the making of women's coats.

The wartime need for conserving, renovating, and reusing discarded articles of clothing has continued through this first year of reconversion. With the development of techniques for the reuse of discarded articles of leather, fur, and felt, the Bureau has now completed its studies on clothing conservation.

These studies have yielded seven printed publications, six articles in professional and popular magazines, and six processed publications. To date, over 1,280,000 copies of the printed and processed publications have been distributed. In addition six different clothing exhibits, prepared to illustrate conservation of materials, have been lent a total of 211 times and are still scheduled for months ahead.

QUALITY OF FABRICS ON RETAIL MARKET

Factual data on the quality of fabrics available to consumers in various parts of the country now afforded by a study of the goods on the retail market are particularly timely.

Supplies of staple clothing fabrics have been shorter during the early period of reconversion than at any time during the war. Four State cooperating agencies were able to procure only 84 staple cotton fabrics in the fall of 1945, compared with 135 in the fall of 1944. Instead, they found considerable yardage of luxury materials, such as eyelet embroidery, at prices ranging from $2.95 to $5.95 or more per yard. Analyses of 675 fabrics purchased periodically in Minnesota, Pennsylvania, Tennessee, Washington, and the District of Columbia revealed excessive shrinkage in many fabrics, exceeding 3½ to 5 inches per yard in several instances; large amounts of sizing, often as much as 10 percent; and objectionable fading in practically all fabrics.

Studies of the serviceability of some all-linen and linen-cotton tea towels, representative of those currently available to consumers, indicate that all-linen towels lose more of their strength during use than towels with a cotton warp and linen or linen-cotton filling. The losses in three qualities of all-linen towels were 14, 30, and 50 percent of lengthwise strength after 10 days' use and 10 washings; in the part-linen-part-cotton towels, 12 to 23 percent. After 25 washings some of the linen towels were too deteriorated for laboratory analyses. The inferiority of the all-linen towels was due in part no doubt to the short-staple fibers used and to the small amount of twist in the yarns.

PROTECTIVE FINISHES FOR COTTON FABRICS

During the last year the Bureau has continued its participation in the cooperative program of the American Association of Textile Chemists and Colorists on the development of methods for testing mildew resistance of fabrics that correlate with service conditions. A total of 35 fabrics treated with various mildewproofing agents have been submitted to four different inoculation procedures and weather-exposure tests. Results of strength measurements of the inoculated and incubated strips of the treated fabrics show that the indirect soil-suspension procedure, based on the method developed by the Bureau, was the most severe method of test. It gave quickly and accurately the best differentiation among the treated fabrics. In the main, results from this simple 14-day indoor-laboratory method agree with those from a direct-inoculation procedure on samples after weather exposure for 6 weeks at Beltsville, Md., during summer months, conditions representative of about a half a season of out-of-door weather in this climate.

In order to determine the micro-organisms that attack cotton fabrics out of doors, cultures were taken from the untreated control fabrics used in the weathering investigations. Fifteen fungi were isolated and their cellulose-destroying ability determined. Species of *Alternaria sp.*, *Macrosporium*, and *Mucor* caused almost complete deterioration.

KNITTED COTTON FABRICS

Continued studies with finishes for cotton hosiery show that for the most part the change in properties was about the same whether a given amount of finish was applied to the yarn before knitting or to the knitted hose.

In developing satisfactory elastic welts for hosiery from medium-staple cotton, single-ply yarn, laboratory tests show that plain-construction knit material had the highest bursting strength and resistance to abrasion, but that the one-way-stretch ribbed fabric was the most elastic and maintained the highest percentage of elasticity under the various loads used. These qualities of the rib knit find extensive use in children's anklet hose.

Exploratory to determining the use to which each is best adapted, a comparative study has been made of the properties of fabrics knit from different fibers, using yarns of the same size in fabrics of identical construction. All-cotton fabrics (except those of mercerized carded yarns) were found to be stronger than rayon materials. Nylon fabrics were strongest, silk second. In insulating value, cotton ranked next to wool, while continuous-filament rayons were lowest. In water absorption cotton was also intermediate, with natural cottons more absorbent than mercerized. In resistance to abrasion, cotton knit fabrics ranked second only to nylon, with natural cotton higher than mercerized and combed cotton superior to carded cotton. Cotton and nylon fabrics were less permeable to air than those of other fibers. Cotton and linen ranked lowest in resilience.

USE OF RESEARCH FINDINGS

The problems of transition from a wartime to a peacetime economy are reflected in the year's information services. Many of the home economics bulletins prepared to aid in wartime situations have been revised. Technical research papers temporarily held in abeyance because of paper shortage were put in form for printing. Work was begun on a new series of publications to guide families in remodeling old houses or building new, and in purchasing new equipment and supplies soon to be available on the civilian market. The international food situation also brought new problems in domestic consumption.

The Famine Emergency Program, for example, called for the preparation of suggestions for consumers on how to conserve bread, cereals, and fat, and how to use the new 80-percent extraction flour. Practical how-to-do-it directions were also brought together for the 1946 Home Food Preservation Program, again organized as a means of safeguarding family diets in this country and making available more commercial stocks for shipment abroad. These information aids took the form of bulletins, press releases, photographs for news and exhibit use, and scripts for radio broadcasting.

Meanwhile the regular program of disseminating findings of new research went forward. Totals for the year July 1, 1945, to June 30, 1946, are as follows: 29 printed and processed publications; 20 technical articles for professional journals; 159 popular articles and fact sheets for press and radio use; 31 radio scripts and broadcasts. A list of the printed material is available in mimeographed form.

Included in the total for printed and processed publications are the year's 10 issues of Rural Family Living—a digest of current information on prices, supplies, and Government regulations affecting food, clothing, household equipment, and other items important in household purchases. Extension workers, Farm Security home supervisors, and others working directly with farm families find this service of great help to them in keeping abreast with the rapidly changing economic situation.

Another noteworthy accomplishment of the year was the production of the educational motion picture Freezing Fruits and Vegetables, filmed in natural color and prepared coincidentally with an illustrated bulletin suitable to be used alone or as "take-home" directions by the motion-picture audiences. A total of 107 prints of the motion-picture film are now in circulation by State film libraries, the Extension Service, and other cooperating agencies, and a number of commercial firms are placing purchase orders. Many of these agencies have ordered quantities of the freezing bulletin, and distribution during the 2 months since issue already totals approximately 320,000 copies. This dual presentation of facts growing out of the research on home freezing will greatly accelerate the spread to the public of practical and timely information.

The Bureau now has on the list for active distribution 62 popular and 45 technical bulletins. Of these, 4,951,349 copies were distributed during the past year on request of homemakers, professional workers in home economics and allied fields, manufacturers and distributors of consumer goods, and administrators and public officials concerned with programs touching human welfare. This demand for published material shows the growing awareness on the part of the American public to the need for research applied to the goods and services used in everyday living.

U. S. GOVERNMENT PRINTING OFFICE: 1946

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 5 cents